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ABSTRACT

An age-normed test battery was developed for use as a research instrument to assess strengths and weaknesses in the sensory-motor development of elementary school age children. The importance of sensory-motor functions for the child's total development and learning is noted. The experimental sensory-motor test battery consists of 12 subtests, and requires approximately 20 to 25 minutes to be administered to an individual child; however, a group of three or four children can be individually tested in about 45 minutes. The subtests are administered in the following order: 1. bead stringing, 2. first-edge-palm, 3. block transfer, 4. bean bag throw, 5. sitting, bending, reaching, 6. standing broad jump, 7. shuttle run, 8. lying on floor to standing position, 9. sit-ups, 10. walking board, 11. one foot balance (eyes open and eyes closed), and 12. chair push-ups. The standardization sample consisted of 744 Caucasian children, 6 through 12 years of age, from Kindergarten through Grade 6. The major evidence at present concerning the validity of the instrument was provided by the factor analysis of the intercorrelations for each age group. The five factors were interpreted as: "hand-eye coordination," "balance," "explosive strength or impulsion," "flexibility," and "visually guided movement." The minimum estimates of internal consistency reliability of the subtests range from .44 to .88. (Author/DB)

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The Development of an Experimental Sensory-Motor and Movement Skills Test Battery[1,2]

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Introduction

Children who manifest learning and behavioral difficulties usually show developmental lags in one or more of the following six areas of psychological functions: (1) sensory-motor and movement skills, (2) language, (3) perception (visual, auditory, and tactile-kinesthetic), (4) higher cognitive processes, (5) social adjustment, and (6) emotional development. An adequate diagnostic evaluation of a handicapped child should pinpoint the nature and degree of the child's strengths and weaknesses in each of the above six developmental areas which are basic to his adjustment. (Frostig, 1967 and Frostig and Orpet, 1972).

On the basis of adequate assessment information, a comprehensive remedial program could be developed specifically geared to each child's individual pattern of abilities and disabilities. Ability training would be provided to strengthen the child's weak abilities and remediation of academic subjects would be designed to capitalize upon the child's strengths.

In recent years, standardized differential ability tests have been developed for the assessment of language abilities (Kirk, McCarthy, and Kirk, 1968); auditory perception (Wepman, 1958); visual perception (Frostig, 1964); and cognitive abilities (Wechsler, 1949). In addition, remedial programs have been developed for several of the above assessment procedures.

However, no satisfactory procedure existed for assessing "sensory-motor and movement skills" abilities. It became apparent to Dr. Marianne Frostig and others at the Frostig Center of Educational Therapy that a differential abilities "sensory-motor and movement skills" assessment procedure and remediation program was needed.

Work has therefore been in progress at the Frostig Center to develop an age-normed "Movement Skills Test Battery" (Orpet, 1972) that would be useful as a research instrument to assess strengths and weaknesses in the sensory-motor development of elementary school age children. Concurrent with the development of the test battery, work has also been in progress to develop remediation procedures for movement skill deficits (Frostig and Maslow, 1969; Frostig and Maslow, 1970).

Importance of Sensory-Motor Functions

A considerable amount of emphasis has recently been placed upon the importance of sensory-motor functions for the child's total development and learning. Piaget (1966) and Werner (1957), in particular, have stressed the importance of sensory-motor activity as basic to the child's intellectual and perceptual development. Ajuriaguerra, a neurologist, stresses the importance of sensory-motor functions to language processes (Roberts, 1966). The child's social and emotional development may also be influenced by his sensory-motor abilities and deficits. Movement education based upon an adequate assessment procedure could be beneficial to the child's feelings of self-worth and his development of social skills (Frostig and Maslow, 1970).

Theoretical Rationale of Test Battery

A considerable amount of previous investigation in the two fields of human factors psychology and physical education had already revealed that sensory-motor competence was highly differentiated. Such writers as Guilford (1958), Nicks and Fleishman (1960), and Fleishman (1964) had already established that separate factors in adulthood and adolescense were related to parts of the body (e.g., whole body vs. limbs vs. hands vs. fingers) and related particularly to performance qualities such as coordination, agility, flexibility, strength, balance, and endurance. It was therefore decided to construct and obtain normative data on a test battery that would attempt to assess the above performance qualities (attributes of movement) with the exception of endurance.

Subtests and Brief Rationale

The experimental sensory-motor test battery consists of twelve subtests. The test requires approximately 20-25 minutes to be administered to an individual child; however, a group of three or four children can be individually tested in about 45 minutes. Time is saved in the group procedure by explaining and demonstrating each activity to the group, and then having each child perform individually. The subtests are administered in the order listed below:

Subtest	Brief Rationale
1. Bead stringing	Bilateral eye-hand coordination and dexterity
2. Fist-edge-palm	Unilateral coordination involving motor sequencing
3. Block transfer	Eye-hand and fine motor coordination involving crossing the midline of the body

Subtest	Brief Rationale
4. Bean bag throw	Visual-motor coordination involving aiming and accuracy
5. Sitting, bending, reach	Ability to flex spine, back muscles and hamstring ligaments
6. Standing broad jump	Leg strength
7. Shuttle run	Running speed and ability to make quick stops, changes of direction, and changes of body position
8. Lying on floor to standing position	Speed and agility in changing body position from a lying to a standing position
9. Sit-ups	Abdominal muscle strength
10. Walking board	Ability to maintain dynamic balance
11. One foot balance:	
a. eyes open	Static balance with eyes open
b. eyes closed	Static balance with eyes closed
12. Chair push-ups	Arm and shoulder girdle muscle strength

As can be seen above, five of the six attributes of movement are assessed. Endurance was not measured for the practical reason of limitation of time.

Standardization Sample

The standardization sample consisted of 744 Caucasian elementary school children from Kindergarten through Grade VI from the Buena Park Elementary School District. The sample sizes at the seven age levels (six-year through twelve-year) range in size from 103 to 109.

Standardization Data

Norms are provided separately for male and female subjects for each subtest by chronological age. The raw scores are converted to scale scores with a mean = 10 and S.D. = 3.

No attempt was made to validate the battery by correlating it with a criterion variable such as an existing test because an adequate criterion measure does not presently exist. The major evidence at the present time concerning the validity of the instrument was provided by the factor analysis of the intercorrelations for each age group (Orpet and Meyers, 1972). The five factors were interpreted as: "hand-eye coordination," "balance," "explosive strength or impulsion," "flexibility," and "visually guided movement."

The lower-bound estimates of reliability based upon the communalities[4] from the factor analysis for each of the seven age groups are presented in Table 1. As can be seen from the Table, the minimum estimates of internal consistency reliability of the subtests range from .44 to .88 with only 14 of the 91 communalities being less than .60.

Insert Table 1 about here

Table 1

Lower-Bound Estimate of Reliability Based Upon Communality from Factor Analysis for Each Age Group

Subtest	6 YR N=106	7 YR N=103	8 YR N=104	9 YR N=105	10 YR N=109	11 YR N=108	12 YR N=107
1. Bead Stringing	60	67	60	61	62	63	67
2. Fist-Edge-Palm	59	60	72	65	44	59	73
3. Block Transfer	59	62	80	65	71	68	71
4. Bean Bag Throw	81	69	68	57	69	81	77
5. Sit-Bend-Reach	79	71	78	88	85	52	71
6. Broad Jump	66	50	74	62	74	60	69
7. Shuttle Run	63	63	71	53	71	61	69
8. Lying to Standing	57	74	48	58	69	68	79
9. Sit Ups	52	80	53	71	50	75	75
10. Walking Board	58	54	63	65	70	67	63
11a. One Foot Balance, Eyes Open	73	67	71	68	60	62	63
11b. One Foot Balance, Eyes Closed	73	65	78	49	61	77	83
12. Chair Push Ups	59	60	72	74	68	72	73

Note - Decimal Points Omitted

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Footnotes

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[2]The development of the test battery was supported in part by a research grant from the Mary J. Palevsky Foundation.

[3]Also research consultant at the Marianne Frostig Center of Educational Therapy.

[4]The total variance of a test is made up of three components: (1) common factor variance (communality), (2) variance specific to that test, and (3) error variance. Both the common-factor variance and the specific variance of a test contribute to its internal-consistency reliability, hence, the reliability or true variance of a test cannot be less than its communality.